Chemistry 129.01, Spring 2017, General Chemistry

Week #14

Class Meetings:

Monday, May 8. What drives chemical and physical changes in matter? We'll discuss Entropy, a thermodynamic state function that is important in determining whether a process is spontaneous and introduce Gibbs Free Energy, a thermodynamic state function that combines two thermodynamic concepts: ΔH and ΔS (Chapter 16).

Wednesday, May 10. Experiment 8: The Goldschmidt Reaction. ***Remember to come prepared for lab (notebook and clothing).***

Friday, May 12. Quiz #11: Thermochemistry (Chp. 5) and Quiz retake (this is optional, please let me know by Thursday morning which quiz you'd like to retake).

Problem Set

***This is not an assignment answers will be posted.**

1. In a particular spontaneous process, the entropy of the system decreases. What can you conclude about the sign and magnitude of ΔS_{surr}?

2. Without doing any calculations, predict whether ΔS is positive, negative for each of the following processes, assuming each occurs at constant temperature:

   (a) Dissolution of $HCl_{(g)}$ in water

   (b) $2NO_{2\,(g)} \rightarrow 2\,NO_{(g)} + O_{2\,(g)}$

   (c) Dew forming

   (d) Dissolution of $NaCl_{(s)}$ in water

3. Using the appendix of your book, compare S° at 25°C for the following pairs of substances and explain the difference in entropy values:

   (a) $CuO_{(s)}$ and $Cu_2O_{(s)}$
   (b) 1mol of $N_2O_{4(g)}$ and 2mol of $NO_{2(g)}$
   (c) $SiO_{2(s)}$ and $CO_{2(g)}$
   (d) $CO_{(g)}$ and $CO_{2(g)}$

4. Using S° values from the appendix of your book, calculate $\Delta S°$ values for each of the following reactions. In each case explain the sign of ΔS.

   (a) $N_2H_{4(g)} + H_{2(g)} \rightarrow 2\ NH_{3(g)}$

   (b) $K_{(s)} + O_{2(g)} \rightarrow KO_{2(s)}$

   (c) $Mg(OH)_{2(s)} + 2\ HCl_{(g)} \rightarrow MgCl_{2(s)} + 2\ H_2O_{(l)}$

   (d) $CO_{(g)} + 2\ H_{2(g)} \rightarrow CH_3OH_{(g)}$

5. Using values from the appendix of your book, calculate $\Delta S°$ (Problem #4), $\Delta H°$, $\Delta G°$ values for each of the following reactions. In each case show that $\Delta G° = \Delta H° - T\Delta S°$. Is the process spontaneous?

   (a) $N_2H_{4(g)} + H_{2(g)} \rightarrow 2\ NH_{3(g)}$

   (b) $K_{(s)} + O_{2(g)} \rightarrow KO_{2(s)}$

   (c) $Mg(OH)_{2(s)} + 2\ HCl_{(g)} \rightarrow MgCl_{2(s)} + 2\ H_2O_{(l)}$

   (d) $CO_{(g)} + 2\ H_{2(g)} \rightarrow CH_3OH_{(g)}$

6. Write the equilibrum expressions for the following and determine the value of the equilibrium constant using $\Delta G°$.
   (a) $N_2H_{4(g)} + H_{2(g)} \rightarrow 2\ NH_{3(g)}$

   (b) $K_{(s)} + O_{2(g)} \rightarrow KO_{2(s)}$

   (c) $Mg(OH)_{2(s)} + 2\ HCl_{(g)} \rightarrow MgCl_{2(s)} + 2\ H_2O_{(l)}$

   (d) $CO_{(g)} + 2\ H_{2(g)} \rightarrow CH_3OH_{(g)}$